WASHINGTON
SCIENCE TRENDS

HIGHLIGHTS

* Space Program Changes
* Boron Fuel Programs
* Navy Radiac Developments
* Research Checklist
* Publications Checklist

Vol. II No. 24 Aug. 31, 1959

Space Program Changes

The personal decision of Administrator Keith Glennan of the National Aeronautics and Space Administration (NASA) to postpone ambitious plans for interplanetary probes may have an important impact on the national space booster program.

Glennan has informed his associates that Project Mercury and lunar exploration will receive top priority in the new NASA budget, now in the preliminary stages. This will mean slowdowns and possibly cancellations of projects aimed at Mars, Venus and other planets in deep space. Among the boosters which would be affected by such cutbacks are the Saturn, an Army Ballistic Missile Agency cluster of eight Rocketdyne engines and the Nova, a cluster of four 1.5 million pound thrust single chamber engines.

NASA officials believe that by concentrating their deep space work on lunar missions an attempt can be made, with some expectation of success, to have an instrumented payload impact the moon's surface by mid-1961.

By that time it can also be decided whether or not to attempt manned exploration of the moon by direct launchings from the Earth. The largest boosters now planned could theoretically accomplish such a mission in the 1964-6 time period, but even with the huge Nova booster a five to seven stage vehicle would be required and Glennan has already rejected the seven-stage concept as impractical.

Meanwhile, with little coordination with NASA, the Pentagon's Advanced Research Projects Agency has embarked on Project Suzano, a feasibility study of space platforms to be placed in a 300 mile Earth orbit as a way-station to the Moon and the planets.

Some informed officials favor a delay in decisions on booster systems for manned lunar exploration until a decision is made on the alternate approaches -- space platform or earth launching. The platform concept, however, has little support at NASA.

Realignment of the booster projects could also affect the program for the Dynasoar, which is expected to lead to a manned orbital bomber. Efforts are now being made to more closely interrelate this program's timetable with the expected development of military and civilian booster systems for added reliability and lower cost.

Boron Fuel Programs

The future of the Government-sponsored boron fuel development program is likely to be decided in the next few weeks. A report by the Arthur D. Little Co. is due Sept. 1, to be followed on Sept. 10 by a meeting of the Defense Department's Joint Working Group on Special Fuels. It is considered likely that some test-batch production will continue for R&D purposes, but that this may be done only on a laboratory scale.

Reporting to the House Committee on Science and Astronautics:

* Navy says its "zip" fuel program has been rendered marginal by rapid advances in the missile field and by the reduction of emphasis on high performance piloted aircraft. Other lesser considerations, include high cost, handling-toxicity problems and logistic problems associated with fleet usage.

Future of boron-based fuels for the Navy lies with continued development of liquid monopropellants, additives for solid propellants and other boron compounds.

* Air Force says its requirements for boron-based fuels are no longer pressing because of improvements in the efficiency of the B-70 bomber, for which it was originally intended. The delay and possible cancellation of the advanced Bomarc ground-to-air missile, another potential boron project, also contributed to recent cancellations.

Future plans of the Air Force include active R&D in the application of boron compounds to rocket propellants as well as advanced ramjets. It has not yet been determined how much production will be necessary for these programs.

* National Aeronautics and Space Administration continues to believe that satisfactory ramjets and afterburners can be developed. The agency also plans to continue work on promising rocket applications of boron hydrides. However, neither project will require production-plant capacity.

Difficulties and major problems encountered by NASA include:

Fuel Injection - Boron fuels decomposed at high temperatures and tended to form a solid before complete burning. This problem was "solved" by designing fuel injection nozzles which mixed air with the boron fuel thereby obtaining rapid burning.

Engine Fouling - The products of combustion of boron fuels (boric oxide) become liquid below about 3000°F. As the temperature decreases, this liquid becomes like glue and adheres to the various parts of the engine, and at 850°F. becomes a solid. First tests demonstrated that a turbojet engine would lose power rapidly after a short period of operation. Research on component parts demonstrated that this problem could be "solved" by increasing the temperature of the engine and making certain other modifications. However, considerable work remains to be done and full-scale engine tests over a wide range of operating conditions would have to be done to obtain a satisfactory turbojet for boron fuels.

Power Loss at High Temperature - NASA experiments on a full-scale afterburner indicated that a 10 to 12 percent energy loss was encountered when operating temperature was raised from 2500°F to 3000°F. At the higher temperature the boric oxide did not condense into a liquid while passing through the nozzle and the energy corresponding to the heat of vaporization was lost. It was found that this problem could be minimized somewhat by nozzle modification.

Fuel Handling and Thermal Decomposition - It was known in advance that the boron fuels are toxic and subject to decomposition at elevated temperatures. Nevertheless, research by various agencies showed that the problems could be solved and data necessary for designing satisfactory fuel systems for aircraft were obtained.

"Hot-Rod Engine" - NASA has now terminated its "hot rod" program for modification of a J-47 turbojet engine to include higher operating temperatures, reshaping of the turbine and stator blades to minimize the deposit of combustion products and lower velocities in the exhaust gas. Parts for this engine have been fabricated, but the project was cancelled when the Department of Defense announced cancellation of the boron fuel program.

Rocket Fuels - NASA believes that boron hydrides still offer promise as rocket propellants since they offer more power than some conventional fuels such as oxygen hydrocarbon, and are more stable than the most powerful rocket propellants such as liquid hydrogen and oxygen or hydrogen and flourine. Advantages are most apparent for long-duration missions and other uses where stability is important.

According to NASA, basic research and engineering knowledge will be required before intelligent decisions can be made on the choice of fuel-oxidizer combinations for specific engines and missions. Therefore, research on the boron hydrides will continue.

* * *

Solid Propellants - House Space Committee, in a report just completed, predicts that liquid chemical propellants will, on the whole, supplant solid chemicals for upper stage use in space systems, while liquid and solid propellants will remain in active competition for use in large boosters.

It is noted, however, that technical improvements are making solid propellants more attractive as boosters, including weight reduction, higher specific impulse, new techniques for rapid thrust termination throttling and control.

The Committee also notes that there are proposals for assembling solid propellant motor cases or chambers at the firing site, along with the mixing and casting of propellants. This, it is suggested, might solve the problem of mobility, since highway transport is restricted by 80,000 pound total weight and 12-foot diameter physical size limitations imposed by load-carrying capacities of highway and railroad bridges and clearances of underpasses and clearances of underpassea dn constructions along rights-of-way.

Navy Radiac Developments

An extensive program aimed toward the development of new and improved radiological detection and measurement devices is underway at the U.S. Naval Radiological Defense Laboratory.

Here is a summary of instruments now being tested in the alpha, beta, gamma and neutron radiation field:

* Alpha Instrument -- This new portable alpha survey instrument, powered by two standard "D" flashlight batteries, will have a scintillation-type detector consisting of a plastic plaque coated with zinc sulfide scintillant. It is expected to be less sensitive to humidity than presently used devices, will be more rugged and will have a higher maximum counting rate.

* Long-Range Beta-Gamma Instrument -- The developmental model of this new unit is completely transistorized, using printed circuitry and miniaturized components wherever possible. The unit can operate for several hundred hours on two flashlight batteries. Two GM tubes serve as detectors, and are housed in the probe. They are said to be capable of beta indications up to 500 milliroentgens per hour.

* Shipboard Radiac System -- This system is now undergoing evaluation to meet anticipated tactical requirements for gamma dose rate information aboard ship. The system includes a detection control unit sensitive only to gamma radiation, three remote readout units and a training aid. All major subassemblies have been duplicated in parallel for maximum reliability. The remote units are planned for use if a ship is caught in a high-intensity fallout field. In such circumstances, it may become necessary to evacuate exposed areas and take shelter in shielded sections of the ship. The remotes will provide information on when these stations can be re-manned.

* Tactical Electronic Dosimeter -- This unit is considered to be a significant departure from many of the current concepts of dosimetry. A recycling ion chamber indicates on a digital counter whenever it has detected a 100 mr (.1r) gamma radiation dose. The accumulated dose is then presented on an easily-read and resettable digital counter. An audible alarm can be set to sound at certain pre-determined doses. The dose rate is indicated by the frequency at which the .1r increments of dose click past. The entire unit weighs two pounds and can be worn on a belt or in a pocket for field use.

Policy Notes

* Power: The Navy's current policy is to use ordinary flashlight batteries as much as possible so as to standardize power supplies and ease the logistic burden of battery supply.

* Transistors: Vacuum tubes have almost been completely replaced by transistors in portable instruments. However, the Navy has found that the low impedance circuitry associated with transistors has reduced the interstage isolation so much that there are undesirable and unpredictable side interaction effects. Problems also exist in operation at extreme temperatures.

Research Checklist

( ) Steel-Weldment Tests: Naval Research Laboratory has developed a metallurgical test for evaluating sheet steels and weldments which employs neoprene rubber as a non-compressible fluid medium. Test apparatus is said to be simple to construct and operate and results obtained thus far are said to be highly satisfactory. Future studies will concentrate on assurance of trouble-free service in welded high-strength sheet metal structures. NRL 5347

(R&D by Welding Metallurgy Branch, Metallurgy Division, U.S. Naval Research Laboratory, Washington 25, D.C.)

( ) New Candlepower Standards: New photometric standards for measuring the candlepower, or luminous intensity of electric lamps, are now available. Inside-frosted lamps with monoplane filaments and medium bipost bases are employed. The new standards are said to show little or no variation in intensity with change in orientation and can be easily calibrated.

(Further information available from Photometry and Colorimetry Section, National Bureau of Standards, Washington 25, D.C.)

( ) Metal Bonding Research: Studies by the National Aeronautics and Space Administration indicate that an unsaturated carbon-to-carbon bond in a polymer promotes high resistance to thermal deterioration in bonds to stainless steel. Adhesives to bond aluminum were also investigated.

(Report available. Free. Write National Aeronautics and Space Administration, CODE BID, Washington 25, D.C. for Technical Note D-108)

( ) Fire Extinguishing Compound: Army is purchasing some 34,000 fire extinguishing units utilizing a new chemical compound said to be twice as effective as any other agent against liquid fuel and electrical fires. Known as monobromotrifluoromethane, the compound can also be used to create a combustion-free atmosphere in combination with helium or nitrogen.

(R&D by the Army Engineer Research and Development Laboratories, Ft. Belvoir, Va.)

( ) Missile Flight Safety: A new flight safety system for missiles is said to provide ground safety officers with another method of control over missiles while in flight. A modified beacon radar system is employed. Multiple radar setups are said to be feasible since the system uses three or four-pulse signals which cannot be generated by radio interference. The pulse command can activate mechanical relays for missile destruction purposes.

(R&D by Armour Research Foundation for U.S. Army Signal Research and Development Laboratories, Ft. Monmouth, N.J.)

Publication Checklist

( ) Reactor Safety and Indemnity, statements, testimony and exhibits presented to Congress regarding indemnity problems for domestic reactor builders as well as atomic liability problems abroad. 122 pages. Single copies free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C. for Hearings - Reactor Safety)

( ) Naval Reactor Program, Hearings held aboard the Nuclear Submarine Skipjack on the status of Naval Reactors. Also includes a history of the Shippingport, Pa. Power Water Reactor program. 81 pages. Single copies free. (Write Joint Committee on Atomic Energy, F-88, The Capitol, Washington 25, D.C. for Hearings - Naval Reactor Review)

( ) Basic Mechanical Engineering, an official Navy Bureau of Yards and Docks manual on design and installation of heating, ventilating, air-conditioning and similar facilities for shore installations. 106 pages. $2.50. (Write OTS, U.S. Department of Commerce, Washington, 25, D.C. for PB 151 693)

( ) Radar-Sonar Displays, a newly published proceedings of an Armed Forces-National Research Council Symposium on the problems of illumination and visibility of radar and sonar displays. Includes results, summaries and interpretations from commercial, governmental and university laboratories. 210 pages. $2.50. (Write Printing and Publishing Office, National Academy of Sciences, 2101 Constitution Avenue, Washington 25, D.C.)

( ) Corrosion Prevention, a Navy manual including data on atmospheric submerged and subsurface corrosion and corrosion on areas which are alternately wet and dry. Describes in detail Navy methods for controlling or minimizing corrosion. 431 pages. $6. (Write OTS, U.S. Department of Commerce, Washington 25, D.C. for Corrosion Prevention Manual)

( ) Rocket Propulsion, a new translation of a study by Irene Sanger-Bredt of the Institute for Jet-Propulsion Physics on the characteristics of hydrogen and water as working gases for reactor-heated rocket motors. Includes a consideration of fission, arc and fusion methods of heating the working fluid. 51 pages. Single copies free. (Write Technical Information -BID, National Aeronautics and Space Administration, Washington 25, D.C. for Tech. Trans. F-1)

( ) Century 21 Exposition, testimony, statements and exhibits relating to plans for a World Science Exhibition to be held at Seattle, Washington in 1961 and 1962. 82 pages. Single copies free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D.C. for Hearing No. 21)

( ) Science Information, testimony, statements and exhibits relating to private and Governmental plans for wider and more effective dissemination of technical information originating in the U.S. and abroad. 182 pages. Single copies free. (Write Committee on Science and Astronautics, New House Office Building, Washington 25, D.C. for Hearings No. 24)